The economics of water

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IS WATER DIFFERENT?

- It is a “universal and indivisible” truth that “the Earth’s freshwater belongs to the Earth and all species, and therefore must not be treated as a private commodity to be bought, sold, and traded for profit … the global freshwater supply is a shared legacy, a public trust, and a fundamental human right, and therefore, a collective responsibility” Barlow & Clarke (2002).
- Vandana Shiva (2002) writes about a clash between two cultures: “a culture that sees water as sacred and treats its provision as a duty for the preservation of life and another that sees water as a commodity, and its ownership and trade as fundamental corporate rights. The culture of commodification is at war with diverse cultures of sharing, or receiving, and giving water as a free gift”.

On the other hand…

- Dublin Principles, adopted at the 1992 ***International Conference on Water and the Environment*** in Dublin, hold that “water has an economic value in all its competing uses and should be recognized as an economic good”.
- Baumann & Boland (1998): “water is no different from any other economic good. It is no more a necessity than food, clothing, or housing, all of which obey the normal laws of economics”.

MY OWN VIEW

- Food, clothing and shelter, like water, are necessities of life, and they are typically provided through the market without any complaint.
- But water ***is*** different, for 2 reasons.
- The fact that water, unlike other household commodities, arouses such passion speaks for itself: for better or worse, water is perceived as having a special significance and this has economic consequences.
- Water has some other ***economic*** features that make it distinctive.

How is water distinctive as an economic commodity?

- It arouses strong public concern
- Public versus private good
- Mobility of water
- Variability
- Cost structure of water
- Problem of collective action
- Legal structure

Water a private vs a public good

- ***Public goods*** Two key properties: ***non-rivalry in consumption*** and ***non-excludability***.
- With conventional goods, one person's consumption necessarily competes with that of another, in that more consumption by one person renders a smaller quantity of that good available for consumption by anybody else. With public goods, more consumption by one person in no way reduces the amount available for others.
- Conventional consumption goods are excludable in that, if this is so desired, it is physically possible to exclude any person from consuming the good. With public goods, if the good is available for consumption by anybody, it is available for consumption by all.

- The abatement of pollution in a lake is a example of a public good: my enjoyment of the clean water in the lake in no way reduces the amount of clean water available for your enjoyment (non-rivalry) and, if the water in the lake is clean for me to enjoy, it is clean for everyone's enjoyment (non-excludability).
- In general, water is both a private good and a public good. When water is being used in the home, in a factory or on a farm, it is a private good. When water is left in situ, whether for navigation, for people to enjoy for recreation, or as aquatic habitat, it is a public good.
- Also, while the water in a reservoir is a private good, the storage capacity ***per se*** may be a public good.

Why does the distinction matter?

- While public goods are likely to be supplied collectively, for example through a voting process, rather than through a decentralized market, it is likely that they will be ***undersupplied*** because people have a selfish incentive to free ride on the collective decision process by understating their true interest in the public good.
- The valuation of public goods is fundamentally different.

- A public good can be enjoyed simultaneously by many while a private good can be consumed by only one party at a time.
- Thus, the value placed on a given unit of a private good is that of a single user –in an efficient market, this will be the user with the highest and best use for the item.
- The value placed on a public good is that of many people, namely all those who care for the item.
- This is why the non-market benefits of environmental preservation sometimes outweigh the use benefits associated with the diversion of water for off-stream agricultural or urban use.

- The public good nature of water in situ, historically associated with navigation, has had a decisive influence on the legal status of water.
- In Roman Law and, subsequently, in English and American common law, and to an extent in Civil Law systems, flowing waters are treated as common to everyone (***res communis omnium***), and are not capable of being owned. These waters can only be the object of rights of use (usufructuary rights), but not of rights of ownership.
- Even though water and law are often complementary inputs, there is a crucial distinction in that land can be owned, while water cannot.

The mobility of water

- Water tends to move around. When water is applied to plants in the field (or to an urban landscape), a substantial portion either seeps into the ground or runs off the ground as tailwater. In addition, in residential indoor uses and most industrial uses there is usually an outflow of wastewater after the use is completed.
- In consequence, there can be ***several*** sequential uses of the same molecule of water since water is rarely consumed fully by a given user; what is left is physically available, in principle, for use by others

- The mobility of water and the opportunity for sequential use make water relatively distinctive as a commodity compared to land, for which such multiple, sequential uses are impossible (except in nomadic societies).
- In consequence, keeping track of water flows is costly. It is often hard to enforce excludability or establish property rights to return flows.
- Water is very different as an asset than land, which is relatively easy to divide and fence.

- The common solution is to resort to some form of ***collective*** right of access; in effect, this internalizes the externality associated with the mobility of return flows.
- A classic example is the riparian water right in English and American common law. The riparian right to the use of water is not a right to a fixed quantity, and it is a co-relative right shared with all other riparians along the same stream.

The variability of water

- Another crucial feature of water is the variability of supply in space, time, and often quality; eg California. One unit of water is not the same as another.
- The variability has affected not just the engineering but also legal, and institutional arrangements; it is one more point of divergence between water and land, and it explains why the property rights regimes are different: it would surely be difficult to apply the ownership rights in land to so variable a resource as water.

Intermittent nature of (ag) demand

- Demand is intermittent, especially in agriculture where crops need to be irrigated only at periodic intervals rather than every hour of every day.
- Until the advent of affordable storage, which has mainly been a phenomenon of the 20th century, the intermittent nature of traditional agricultural demand was an important factor promoting the ***sharing*** of access. If there is water in the stream and one member of the group is not currently diverting water from the stream, other members of the group were allowed to divert the water rather than let it flow to "waste" in the ocean.

Implications

- Tradeoff between flexibility and formality in establishing property rights.
- Flexibility has benefits (cf adaptive management, in another context); it also has costs.

- What is an optimal property right at one time may not be so optimal at another

The cost of water 1

- Water is bulky, and expensive to transport relative to its value per unit of weight. Consequently, the transportation infrastructure for water is far less extensive than that for more valuable liquids such as petroleum.
- Compared to electricity, water is relatively expensive to transport, but relatively cheap to store. Therefore, the strategy for averting shortage takes a different form with water than electricity.

The cost of water 2

- Compared not only to manufacturing but also other public utilities, surface water supply is exceptionally capital-intensive.
  - In the US, operating costs are only about 10% of total costs for water supply, 32% for natural gas, and 57% for electricity.
- There are very significant economies of scale in storage, conveyance of surface water. Much less so for groundwater. Also, economies of scale for treatment and distribution.

- The capital used in water supply cannot be moved to another location and are generally unusable for any other purpose; they represent an extreme type of fixed, non-malleable capital.
- Furthermore the physical capital in the water industry is very long-lived.

CONSEQUENCES OF THE DISTINCTIVE COST

- The capital intensity, longevity, and economies of scale mean that water supply and sanitation costs are heavily dominated by fixed costs. In a simple surface-water supply system the short-run marginal cost of water supply and sanitation may be almost zero

- This is why water (unlike electricity or gas) was not metered.
- Thus, there is an unusually large difference between short- and long-run marginal cost in water supply.

- Another is the propensity to lumpiness (gigantism) in water supply systems. Because of the economies of scale, there is a strong incentive to make a substantial expansion of capacity at a single point in time rather than to plan for a series of incremental changes spread out over time.
- The drawback is that it may take many years, or decades, before the demand materializes to utilize this capacity (and the willingness to pay to finance it). When fully utilized, the project provides water at a low cost; but there is uncertainty whether and when it will be fully utilized; meanwhile it ties up scarce capital.
- Large surface water projects are risky, and difficult, inter-temporal balancing acts

Cost structure complicates financing

- The capital intensity and longevity of physical capital create grave problems of cost allocation and make financing hard.
- If the costs were mainly operating cost it would be very simple to rely on “the user pay principle” and pay-as-you-go financing.
- As it is, the capital intensity and capital longevity mean make it very hard to have “user pay.”
- One ends up relying heavily on transfers:
  - between one group of users and on other
  - between one generation and another
  - between non-users (the developed countries) and users.

How water supply was financed

- In the 19th century the development of urban water supply in the US and western Europe was financed by the water users:
  - By monthly connection fees (not by volumetric pricing)
  - By special assessments levied on property owners, with their express consent
  - By municipal property taxes (when these became generally available, after ~1860)
- Property taxes were seen as especially appropriate
  - This was a form of benefit taxation: the fire protection and “health” benefits of flushing streets raised adjacent property values. These also made water a local public good.

Consequences, continued

- The capital intensity and economies of scale of surface water supply are classic pre-conditions for natural monopoly. They foster ***public*** provision of a surface water supply, whether by a collective of the users or a monopoly seller, rather than individual, self-provision.
- But it has been recognized since Olson (1965) that the provision of goods through collective action may be flawed because of a failure of incentives.

The problem of collective action

- Olson challenged the optimistic notion that individuals with common interests can necessarily be counted on to act voluntarily to further those common interests.
- The problem arises from harmful coincidences of rivalness/non-rivalness in benefits combined with excludability/non-excludability in costs. Examples are free riding by members of the group who withhold their individual contribution but can still benefit from the results of their colleagues' efforts, and rent seeking by individuals who seek to capture for themselves the benefits of collective action while throwing the cost on others.

The price of water

- The prices which most users pay for water reflect, at best, its physical supply cost and ***not its scarcity value***.
- Users pay for the capital and operating costs of the water supply infrastructure but, in most countries, there is ***no*** charge for the water ***per se***. Water is owned by the state, and the right to use it is given away for free. Water is thus treated differently than oil, coal, or other minerals for which the USA government requires payment of a royalty to extract the resource.

- Thus, where water is cheap, this is because the infrastructure is inexpensive, or the water is being subsidized, rather than because the water is abundant

- There is an additional tendency to under price water – urban as well as agricultural– because public agencies set price to cover the ***historic*** (past) cost of the system rather than the ***future*** replacement cost. There is typically a large gap between these two costs because of the extreme longevity of water supply assets.

- The capital intensity of the capital exacerbates the problem because, after a major water project is built, since capacity so far exceeds current demand there is a strong incentive to set price to cover just the short-run marginal cost (essentially, the operating cost), which is typically minuscule.
- As demand eventually grows, it is economically optimal to switch to pricing based on long-run (i.e. replacement) marginal cost, but by then the water agency is politically locked into low water prices.
- Erie & Joassart-Marcelli argue that this pricing encouraged urban sprawl, in Southern California; they fail to recognize the economic logic that drives it.

The essentialness of water

- Water is essential for all life. In economics, there is a concept, also called essentialness, that formalizes this. An essential input has the property that ***no*** production is possible when this input is lacking. An essential final good has the property that ***no*** amount of any ***other*** final good can compensate for having a zero level of this commodity, then it is said to be an essential commodity
- Water obviously fits this definition as a final good. Water also fits the definition as an essential input in agriculture and several manufacturing industries (e.g., food and beverages, petroleum refining, lumber and wood products, paper, chemicals, and electronic equipment) that cannot function without some input of water.

- However, essentialness conveys no information about the productivity or value of water ***beyond the vicinity of the threshold***. It implies nothing about the marginal value associated with, say, applying 2 versus 3AF/A of water to irrigate cotton in the Central Valley of California. It says nothing about the marginal value of residential water use at the levels currently experienced in Western Europe or the USA –the latter averages about 455–530 L/day per person, more than two orders of magnitude larger than the minimum quantity that is needed for human survival

Essentialness masks a more interesting story about demand

- Water contributes in important ways to the enjoyment of the satisfactions of life.
- If one examines history, water consumption has grown over time through the steady accretion of end-uses, each representing the discovery of a new way to employ water for people's use and enjoyment.
- The result has been a constantly rising trajectory of per capita household water use.

- When a piped water supply first became available in the 19th century, the initial household uses were the same ones that had existed when family members had to fetch water from an external source – drinking, cooking, hand washing, and limited bathing.
- As time passed, many other uses were found – tubs for bathing, water borne sanitary waste disposal, outdoor landscape and garden watering, automatic clothes washers, swimming pools, automatic dish washers, car washing, garbage disposal, indoor evaporative cooling, hot-tubs, lawn sprinklers, etc.

Policy Issues in California

- The mess of surface water rights
- The lack of rights as an obstacle to water marketing
- The void of groundwater
- The difficulty of “balancing”
- The lack of a governance structure

Surface water rights

- Many appropriative rights are essentially unquantified.
- They are also largely unmonitored.
- In many areas, on the ground, we actually have something more like a riparian system
- This creates a problem for water marketing
- It is also a large problem for adaptation to climate change

Water markets

- There are issues regarding equity and the assignment of property right that have to be dealt with.
  - The IID experience
- The existing water markets are marked by an overwhelming preponderance of short-term transfers.
  - Why is this?
  - Is this good?

The void of groundwater

The lack of a governance structure

- Take the Bay/Delta, 58 years later.

- Two hard decisions:
  - What is to be done?
  - Who is to pay for it?

Thank you!

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